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# Basic theory of sampling procedures

## *IOTC ROS SFO TR11*

Category: Sampling procedures

*IOTC ROS SFO TR11*



The IOTC Regional Observer Scheme (ROS) has as its core objective: to collect verified catch data and other scientific data related to the fisheries for tuna and tuna-like species in the IOTC area. In addition, observers may be required to carry out scientific work as requested by the IOTC Scientific Committee.

The series of presentations associated with this module aims to familiarize Observers with sampling methods, requirements, procedures, and units used in the collection of scientific data on-board vessels as these will be used daily in their routine work. Topics include:

- basic sampling methods and strategies;
- tools, units, codes and formats used by IOTC ROS in the collection of biometrics;
- IOTC ROS standard maturity scales (if any);
- collecting, preserving, storing and recording samples;
- taking photograph for species ID; and
- collecting information on tagged specimens



## Sampling strategies

1. They are the approaches to select samples on-board a vessel
2. Determined by operational nature of the fishery and specific data collection requirements
3. Observers require the knowledge and training on how to undertake various strategies to obtain the samples they can analyze
4. Most sampling strategies have a statistical component that is important to ensuring that samples are representative of the total catch

Sampling strategies on-board a vessel, are determined by two main factors:

the operational nature of the fishery, such as purse-seine and poling) where large quantities of fish are caught and processed in a relatively short time or longline and gillnet where catches from a single set can be spread out over an extended period of time, a day or more ; and

specific data collection requirements specified by the IOTC or fisheries managers for that fishery.

Overall all, sampling has a statistical component and to be accurate the relative sampling strategies must be followed.



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## Sampling Objectives

**The different sampling strategies can be used to meet the various sampling requirements which for the IOTC include**

- total catch estimation
- catch composition
- size and weight composition
- biological sub-sample (sex, maturity stage and collection of samples)

**This information is the basis of observers function in the ROS**



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The different sampling strategies can be used to meet the various sampling requirements referenced in the IOTC Resolution 11/04 that require observers to record a broad range of information on:

- fishing gears;
- fishing effort;
- estimated catch;
- catch composition;
- by-catches and discarded catch; and
- biometrics of catch and by-catch.

These categories providing only the broad headings of sampling procedures and information that observers are required know.

This information is the basis of the observers function in the ROS.



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## Sampling Methods or Strategies

- Exhaustive sampling
- Proportional sampling
- Random sampling
- Stratified sampling
- Systematic sampling

**The sampling method utilized must be well documented!**



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Other than Exhaustive sampling all other sampling strategies work on collecting a manageable “sub-set” of the whole catch. The statistical science behind these strategies are that the sub-set selected should be representative of the whole catch. In practice this is not easy to achieve and depending on the characteristics of the catch that we are looking for, the most appropriate strategy or combination of strategies can be used.

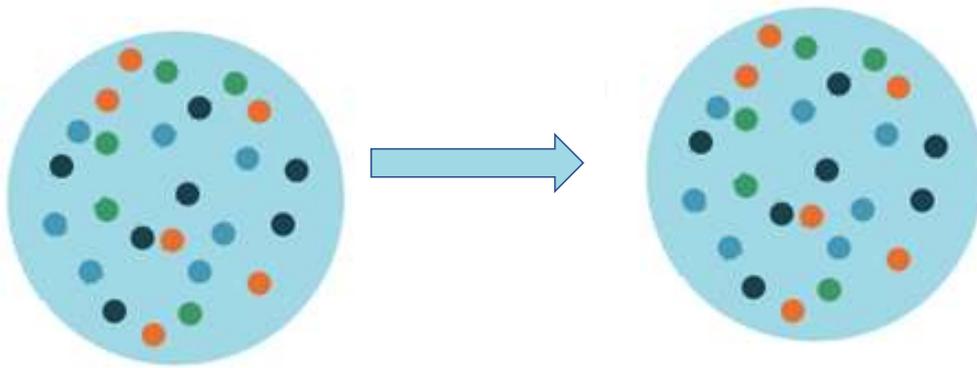
For a homogeneous catch, such as a purse seine catch of tuna from a free school or a pole and line vessel, a relatively small sample may be sufficient to provide the data for species and size composition.

On a longline vessel, where the line can cover an area over 100 km there can be a large difference in the species and size composition along the length of the line, therefore, a much larger sample or even the whole catch should be sampled.

In all cases, it is imperative that observers record in detail how they sampled and the strategies they used.

## Exhaustive sampling

Entails sampling the totality of the population (100%)



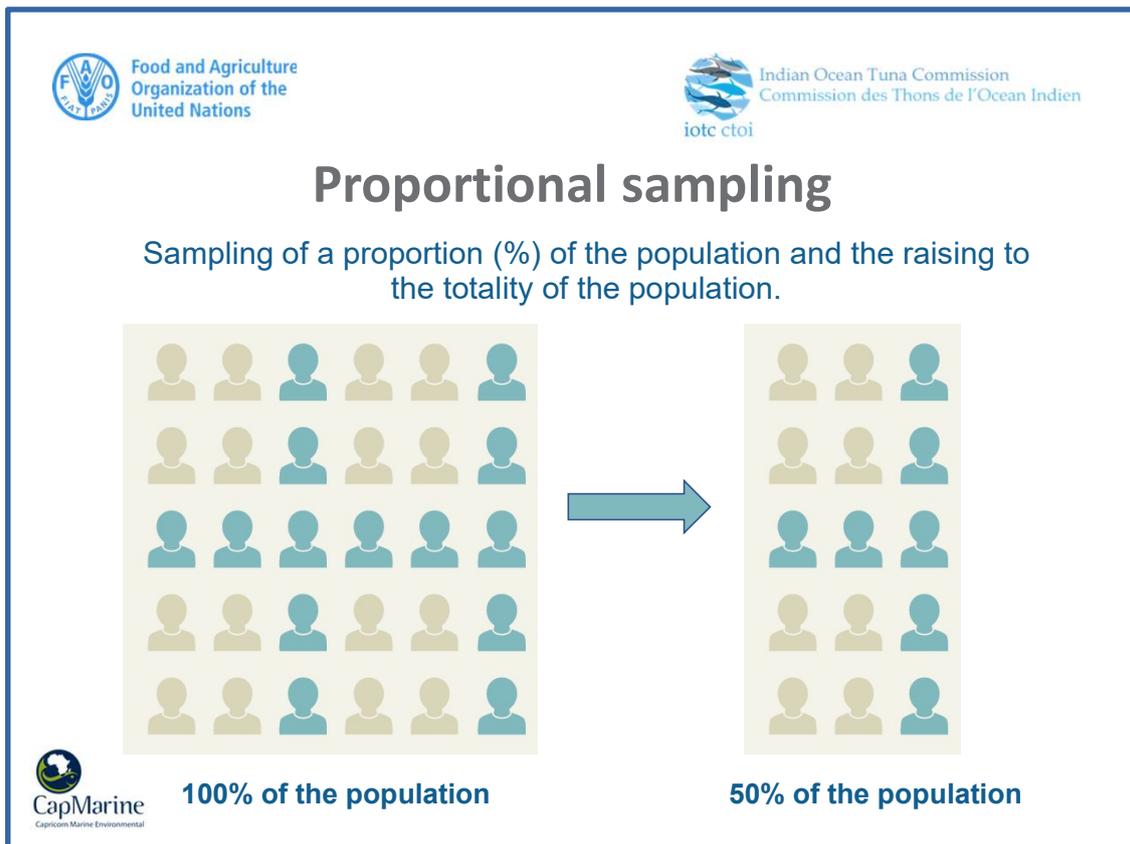
**Exhaustive sampling** is a method of sampling that involves the sampling the totality of the population (catch, species).

In some fishing events the total catch may be small enough or spread over an extended time to allow for all operations to be fully monitored and the catch sampled.

However, in many cases this is not possible and exhaustive sampling is combined with other sampling strategies.

### Examples:

1. The totality (100%) of the hooks or net panels hauled during a longline or gillnet set are observed;
2. The observer weighs/counts every individual caught during purse-seine set (only feasible if the catch is small);
3. The observer counts all fish that land on the vessels during the pole-and-line fishing event;
4. All individuals caught for a particular species are subsampled (exhaustive sub-sampling).



**Proportional sampling** is a method of sampling that involves the sampling of a proportion (%) of the population and the raising to the totality of the population. An important criteria in proportional sampling is that it is a proportion of the total that is decided before the event. It is, therefore, a good system when either a total number or catch weight can be estimated.

#### Examples:

1. For a long line vessel, a fixed number of hooks are set. A decision can be made to monitor and record the catch on a percentage of the hooks set. For example: 10% of 3000 hooks set would require that 300 hooks be monitored as they are hauled. A random strategy can then be used to select the hooks to monitor.
2. For a purse seine vessel, a decision may be made to sample a fixed percentage of the catch. The vessel estimates it caught 80 tonnes and that at 2-tonnes per brail it will take approximately 40 brails to empty the net. If it is decided to sample 10% of the net for catch composition, that would require sampling 4 brails fully for catch composition. The 4 brails would be selected on a random basis.
3. For a gillnet vessel, a proportion (%) of the gillnet is observed by sampling all panels hauled for a period of 1 hour every two hours;
4. For a pole and line vessel, the observer can select two pole fishers and counts fish caught for a period of 5 min every 15 min.



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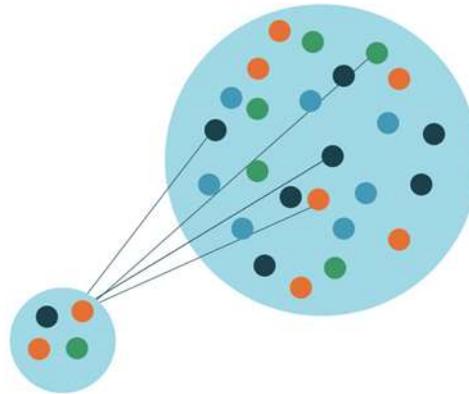


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## Random sampling

Sampling of a part of the population via the collection of multiple samples randomly selected and raised to the totality of the population.

Every individual has a equal  
and independent chance of  
being selected from the  
Population.



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As mentioned, in the science of statistics, sub-sampling is concerned with the selection of a subset of individuals from within a population to estimate characteristics of the whole population.

**Random sampling** requires that the samples collected randomly (i.e. with no pre-determined factors influencing the selection). Determining the random selection is often a challenge. Statistically, random sampling tables can be generated to provide which hook number or gillnet panel to sample. Practically this is difficult as the observer would have to count the hooks or net panels to meet the random number criteria resulting in a large amount of effort and time wasted. Therefore, random sampling is often combined with other sampling strategies.

### Example:

1. Hooks are sampled randomly by selecting at random batches of 10 hooks along the length of the longline
2. The observer selects two pole fishers at random and counts fish caught for 5 min periods, the periods also randomly selected
3. The observer samples all individuals of a particular species present on a purse-seine with the brail randomly selected



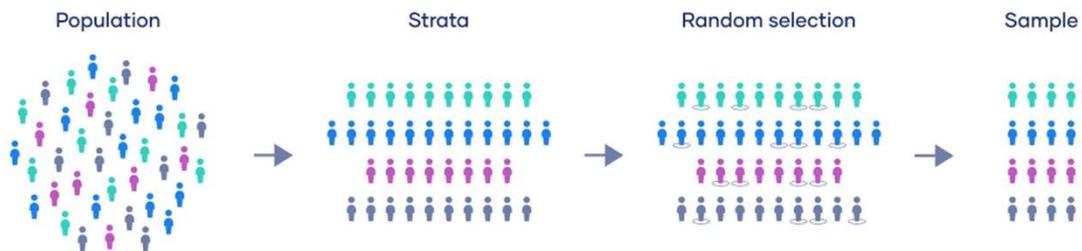
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## Stratified sampling

The division of a population into smaller sub-groups known as strata, that are mutually exclusive.



In stratified sampling or stratification, the strata are formed based on members' shared attributes or characteristics (in this example colour).



**Stratified sampling** basically requires selecting pre-determined subgroups (strata) from a catch or fishing event. The key to understanding this is to understand the term “strata” and then select samples from each strata. The strata are formed based on members' shared attributes or characteristics such as a size group or species.

### Example:

1. The main target species on a longline is swordfish. Swordfish are selected as a strata (by species) and can then be randomly selected to obtain length frequency that represents the total catch for this species.
2. An example for purse seine where catches of juvenile tuna around FAD's are an area of concern, the first strata to select would be tuna, then different size strata could be selected, i.e. fish less than 15 kg, fish between 15 and 50 kg, and fish over 50 kg. Brails of fish are selected randomly and the observer counts all the fish in the selected brail for each size strata.

Stratified random sampling is also called **Proportional Random Sampling** or quota random sampling.

### Important!

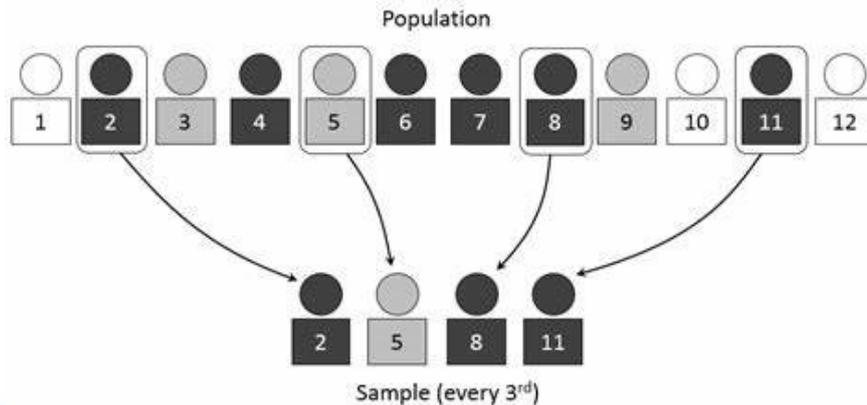
Stratified sampling is used to highlight differences between groups in a population, as opposed to simple random sampling, which treats all members of a population as equal, with an equal likelihood of being sampled



## Systematic sampling

Systematic sampling is a sub-sampling method that involves the organised, regular sampling of a sub-sample of the population.

This sub-sample can be collected randomly or proportionally.



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For example: random samples can be taken from a catch over a period and for each sample the species composition is recorded, or a proportional samples of a predetermined species can be selected and sampled for biometrics.

### Example:

1. Of the random sample taken, the fish are identified to species level. Once the main species have been determined, a pre-determined number of fish of each species is sub-sampled.
2. Of the random sample taken, a small random subsample is taken and biological information extracted.
3. A proportion (%) of the catch or of the individuals caught and brought on-board for a certain species is subsampled in a systematic way (e.g. every 10th fish caught is sub-sampled for length frequency).



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